Amorphous Diamond Electron Emission Capabilities: Implications to Thermal Generators and Heat Spreaders

James C. Sung [*,1,2,3], Kevin Kan[1], Michael Sung[5], Jow-Lay Huang[4], Emily Sung[6], Chi-Pong Chen[1], Kai-Hong Hsu[3] and Ming-Fong Tai[7]

Address: KINIK Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan, R.O.C.

Tel: 886-2-2677-5490 ext.1150

Fax: 886-2-8677-2171

e-mail: sung@kinik.com.tw

[1] KINIK Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan, R.O.C.

[2] National Taiwan University, Taipei 106, Taiwan, R.O.C.

[3] National Taipei University of Technology, Taipei 106, Taiwan, R.O.C.

[4] National Cheng-Kung University, Tainan, Taiwan, R.O.C

[5] Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A.

[6] Johnson and Johnson, Freemont, California, U.S.A.

[7] Department of Electronic Engineering, Wufeng Institute of Technology, Chia-yi 621, Taiwan, R.O.C.

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Abstract

Amorphous diamond represents a class of material of its own. It may be viewed to be a composite of metal (graphite) and insulator (diamond), but together they form a unique passage for electrons to flow through and to emit in vacuum. Amorphous diamond contains much defect so its electrical resistance is intermediate between metal and semiconductor. However, its ability to emit electrons in vacuum as cold cathode outstrips almost any class of materials. The easiness for electrons to flow through amorphous diamond and fly toward an anode across vacuum makes it an ideal material for electrical generator. In fact, the electricity generation can be so easy that amorphous diamond may become the most efficient solar cell ever invented. Moreover, by reversing the role of electricity generation, an amorphous diamond film may become an electron radiator. Such a radiator may dissipate heat much faster than the most advanced heat spreader (e.g., diamond substrate or heat pipe) currently being investigated.

Recent experimental results has confirmed that the current of electron emission in vacuum has increased two orders of magnitude when amorphous diamond is heated to 300 ^{o}C. Such a dramatic increase of current indicates that thermal energy can indeed shake off electrons in carbon atoms and accelerate them toward an anode across a vacuum. This phenomenon is consistent with the proposal that amorphous diamond can indeed be made of solar cells and/or heat spreaders.